The UAS Science Mission Computer:
A Building Block for the Airborne Sensor Web

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Suborbital Science Program

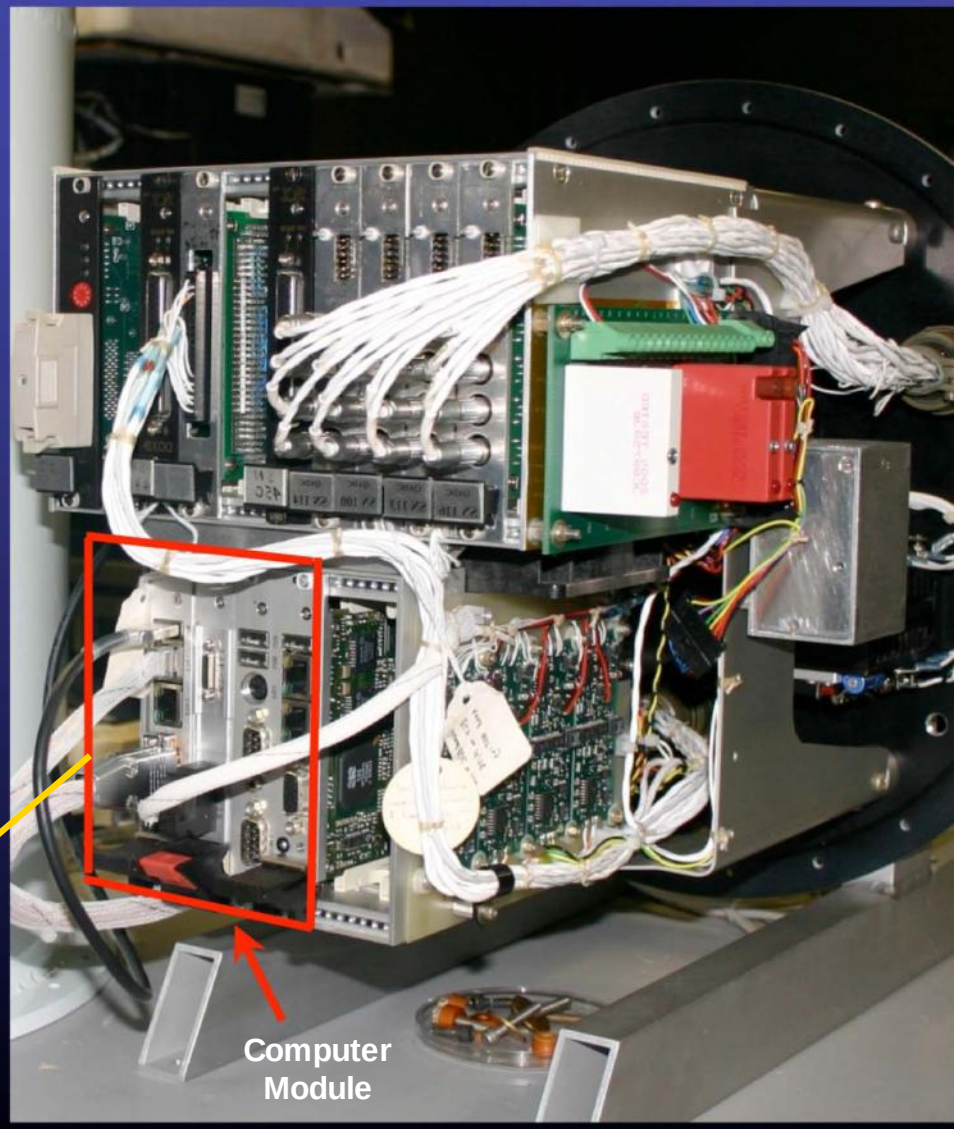
Disaster Management Applications Program

Purpose

- An on board multi-purpose computer to:
  - Reduce data volume required for telemetry
  - Run science algorithms to generate decision products
- Central sensor/payload command & control device
  - Hosts IMM, CDE, and SensorML tools
- Provides a common Interface to complex Sat-Com Systems

UAS Science Mission Computer:

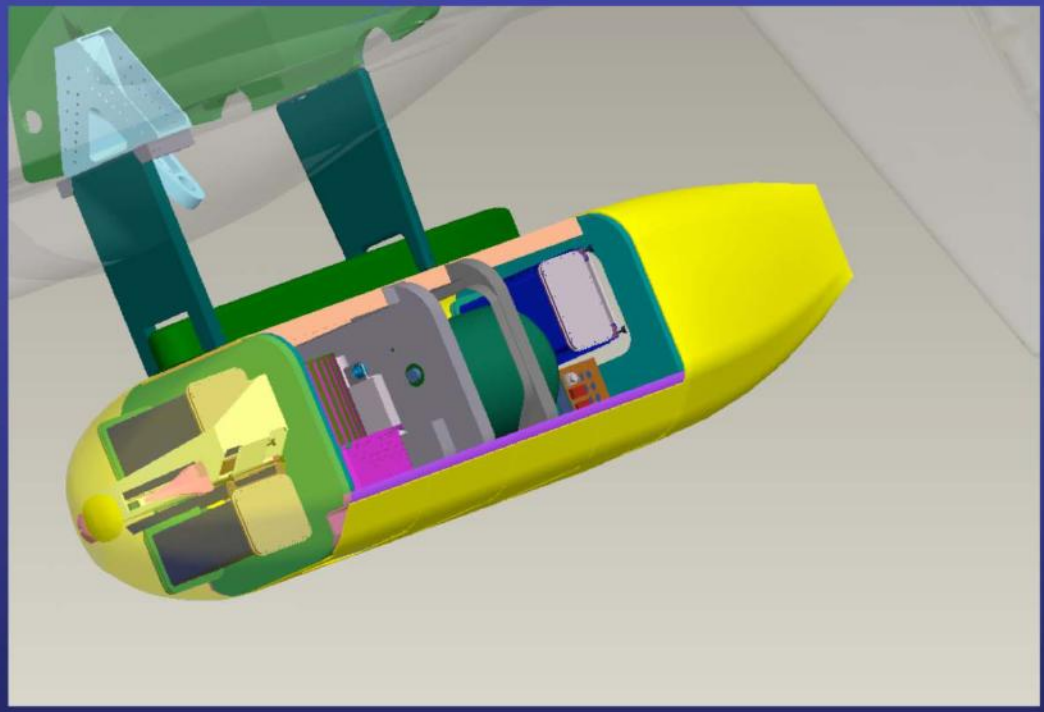
- A Universal Payload Interface to Airborne Ku- , L- , & S- Band Telemetry Systems
- Fast CPU & Solid State Storage For Experimenter Data & Algorithms
- Inputs for ~20 instruments; Up To 40 Mbs Throughput
- Real-time on-board generation of Level-1 & 2 geophysical products, Geo-Tiffs and JPG-2000s
- Interface to IMM/Collaborative Decision Sensor Web Environment
- Stand-alone packaging in FY07, for Ikahana/Altair



ASTL
Ames Research Center

UAS Common Sensor Pod

- Internal Capacity: 1,500 lbs (approx.)
- Removable lower pallet for carrying payload
- Inter-changeable mission-specific pallets
- Common electrical & mechanical interfaces

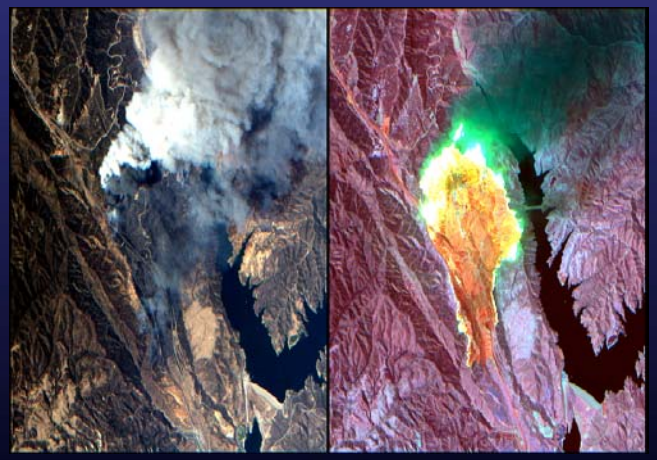


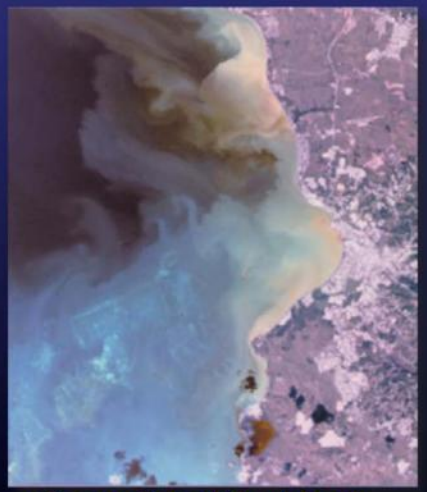
(Renderings courtesy of General Atomics)

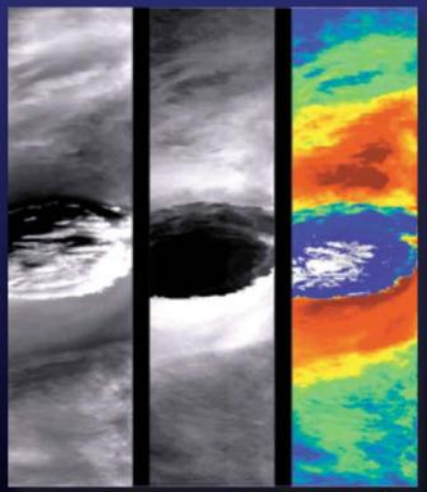
AMS: The UAS Autonomous Modular Sensor

- Separate Configurations for Land Surface, Ocean Color, and Atmospheric Mapping
- Extensive on-board processing capabilities
- Embedded precision navigation system
- Real-Time telemetry and product generation
- Compatible with large UAS (Predator-B, Altair, Global Hawk) or conventional aircraft


General Atomics Altair UAV

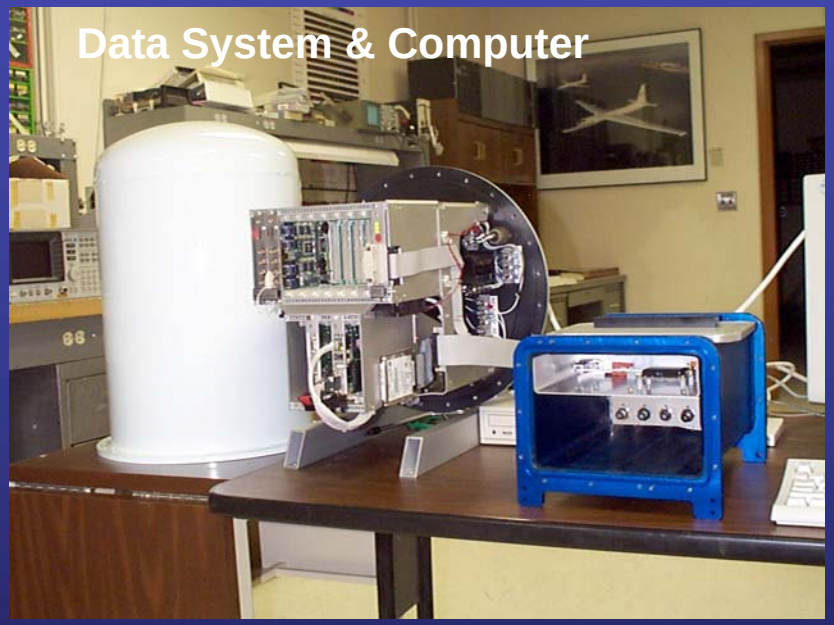

Wild Fire Research

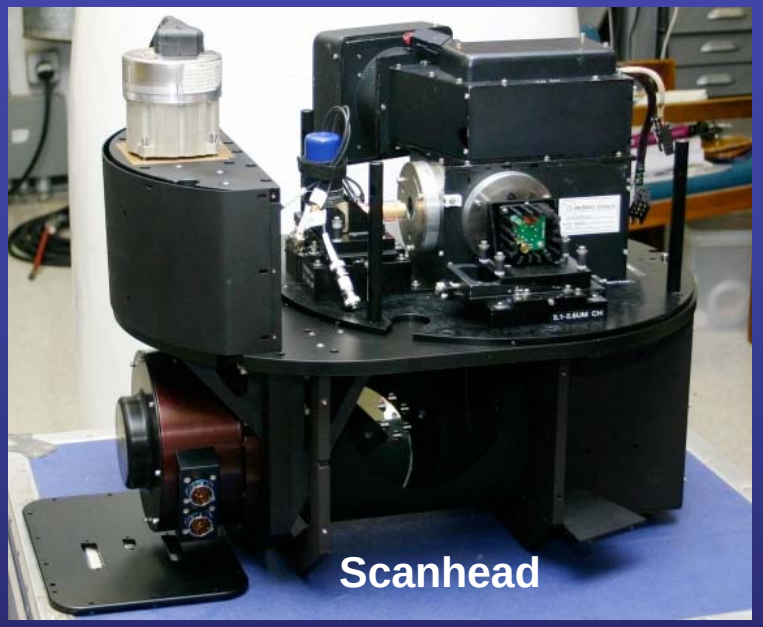

Ocean Color / Coral Reef Research

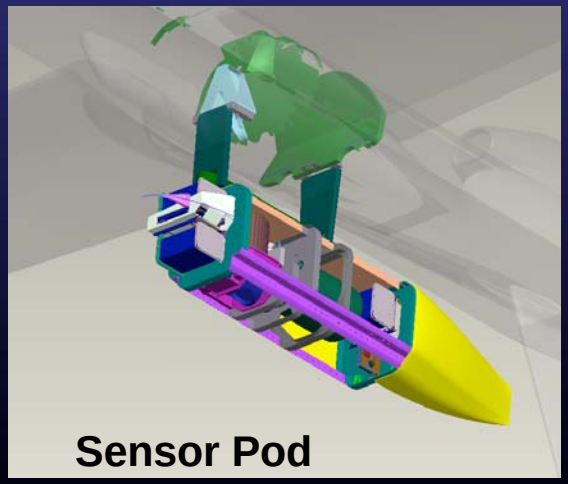

Hurricane and Atmospheric Studies

Commonalities - NONE

AMS System Components







UAS-AMS Image Data Flow Diagram

(Western States Fire Mission, 8/06)

Airborne Element

Line Scanner

POS/AV IMU/DGPS

Digitizer

- Image Data Capture (ADC)
- POS-AV Data Ingest

Shared Storage

Science Mission Computer

- Ku-Band Telemetry Interface
- Level-1B, -2 Product Generation
- Image Geo-Rectification
- SRTM DEM Database

Full Res. 200Hz Data (RS-232)

Ku Sat Com Link

3 Mbs Link (Forward Only)

9.6Kbs Duplex Channel

Ground Element

CDE Agents

Web Server

- Collaborative Decision Environment (CDE) Host
- Intelligent Mission Management SW
- Image & Map Server

Shared Storage

Ground Computer

- Instrument C&C
- Query Handling
- Instrument Engineering Data
- Vehicle Data
- Product QA/QC

Data/Telemetry Link Module
For Altair/Predator-B Payload Instruments

- Experimenter interface to the aircraft Ku-Band Telemetry System
  (Up to 3MB/s allocated for payload)
- Accommodation for >20 instruments
- Multiple interface protocols:
  - Ethernet x 2
  - Firewire x2
  - USB x 2
  - RS232 x2
  - RS-422/485 x4 MultiProtocol

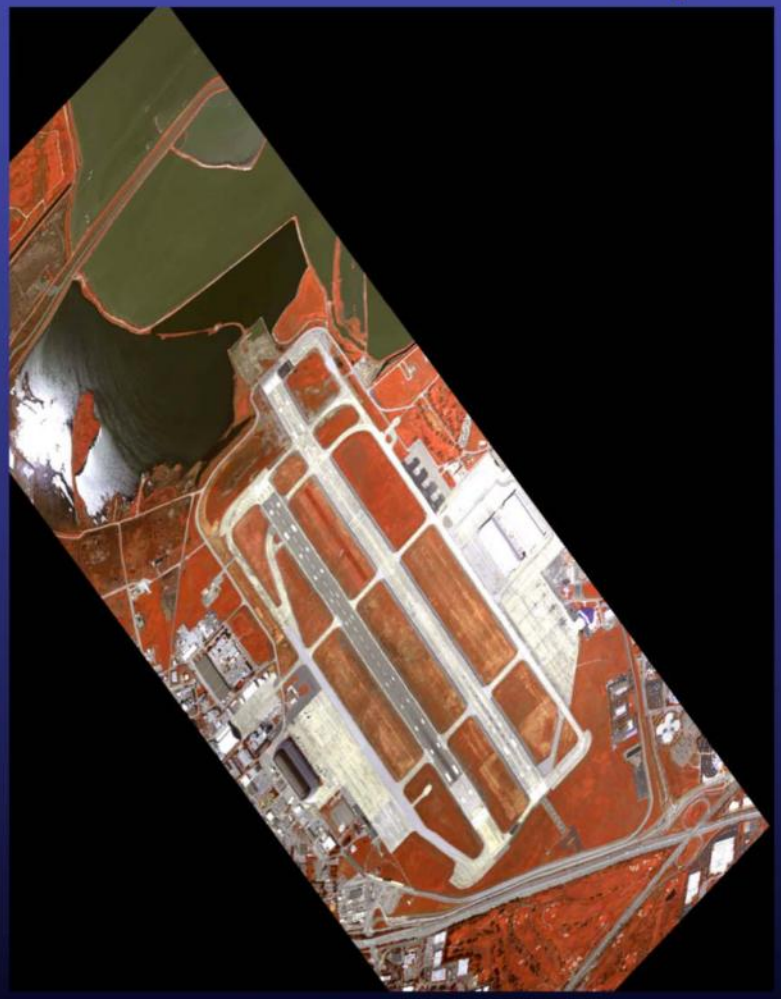
Proposed Electronics Housing for Stand-Alone Configuration (ER-2 type)

- 9.6Kb/s return link for instrument command & control
- Direct Interface to Altair/Predator-B INU
- 20 GB Solid State storage available for experimenter data
- Device and platform independent
- Weight: 9 Kg

Airborne Wildfire Mapping Sensor

Inaugural Flight

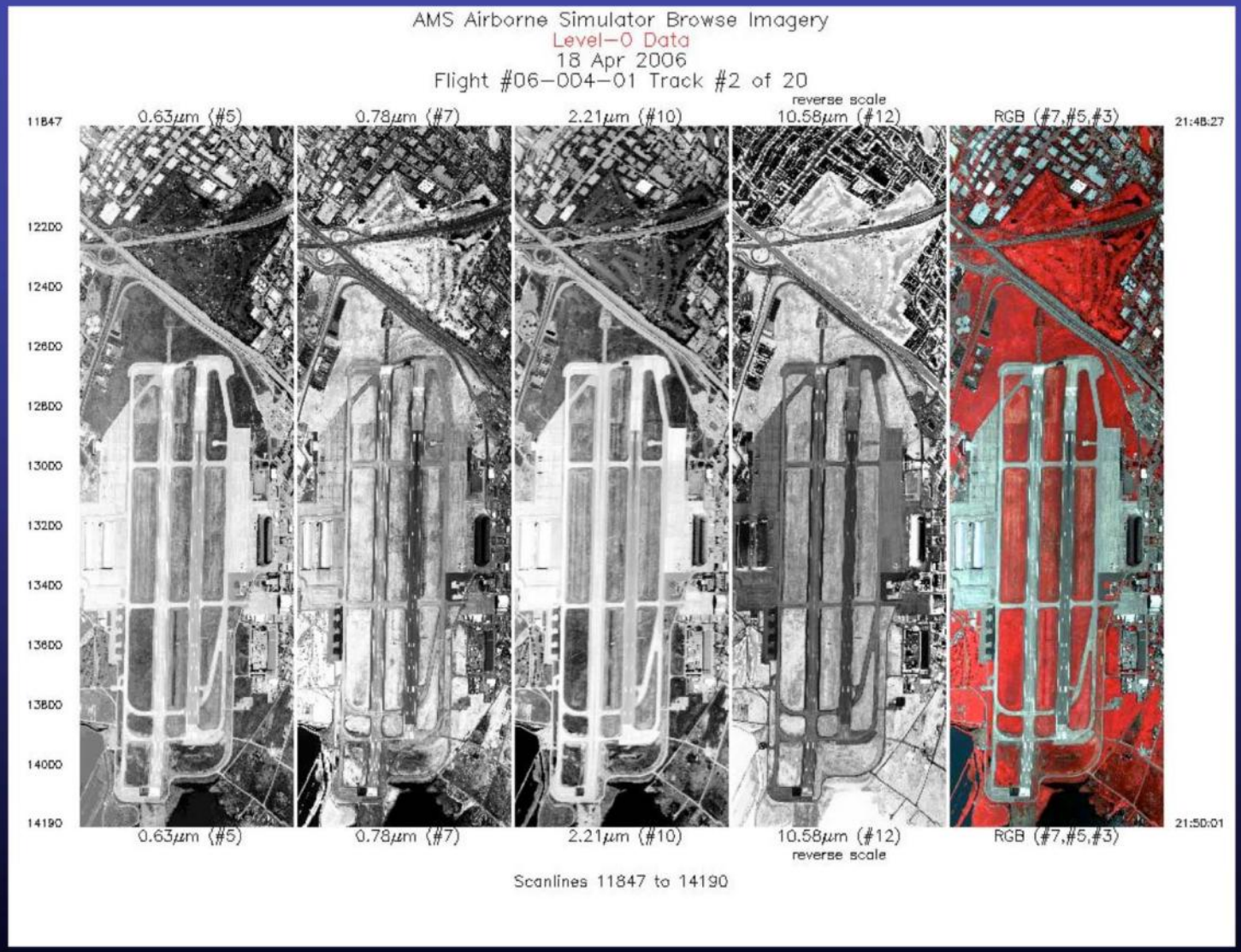
April 18, 2006



Moffett Field, CA

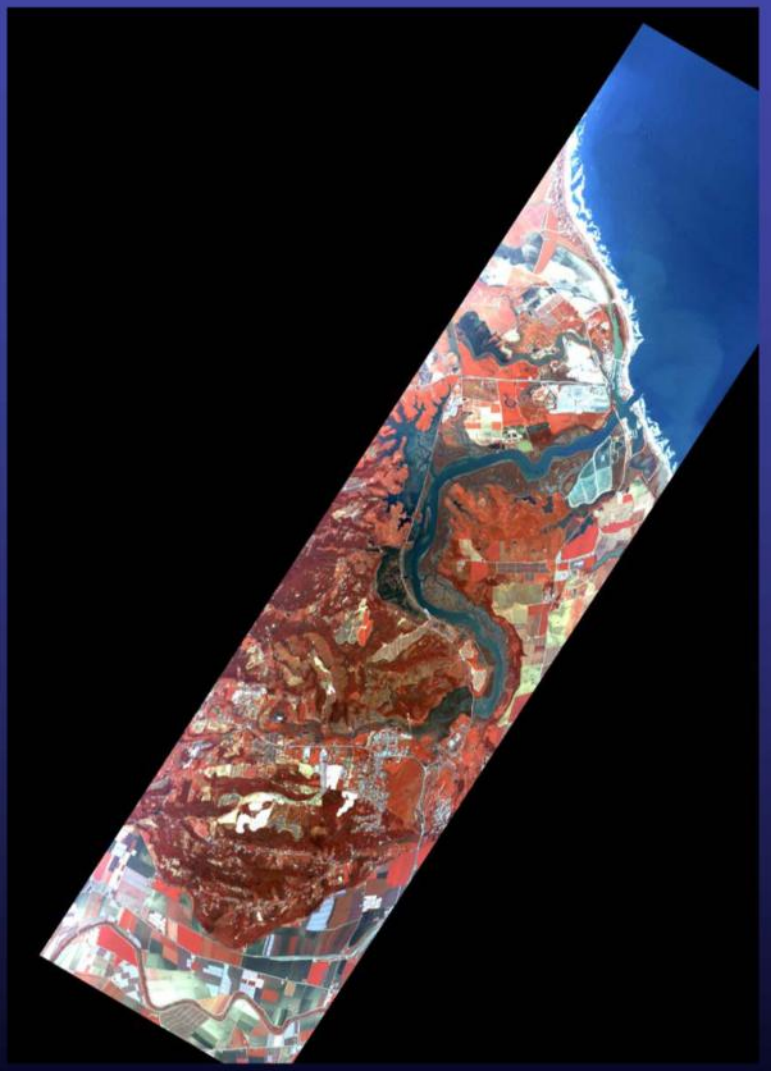
Moffett Field, CA

Airborne Wildfire Mapping Sensor



Moffett Field, CA
Archive Quicklook

Airborne Wildfire Mapping Sensor ML1

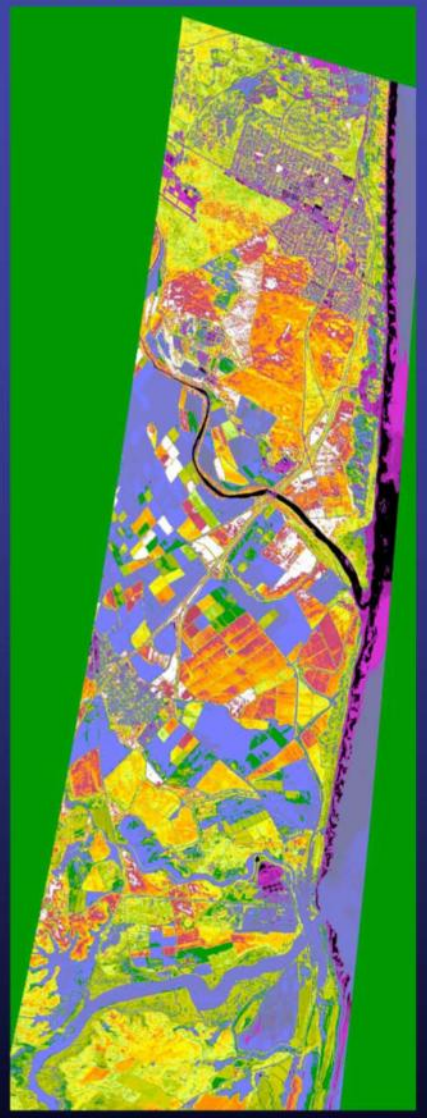


Moss Landing, CA

Airborne Wildfire Mapping Sensor ML 2

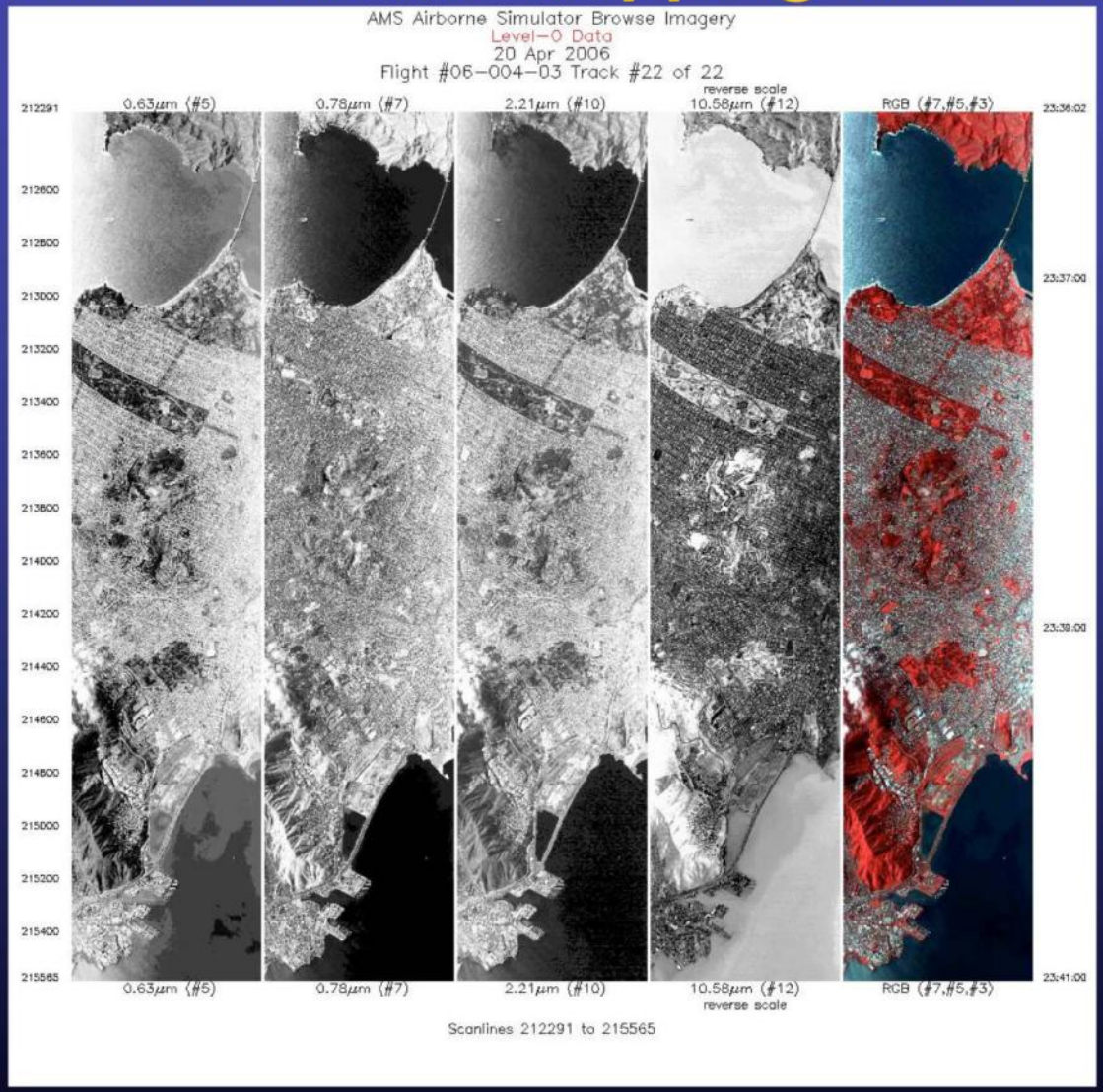
Moss Landing, CA (CIR)

Moss Landing, CA (NC)



Moss Landing, CA (NDVI)

Airborne Wildfire Mapping Sensor SF



San Francisco, CA
Archive Quicklook

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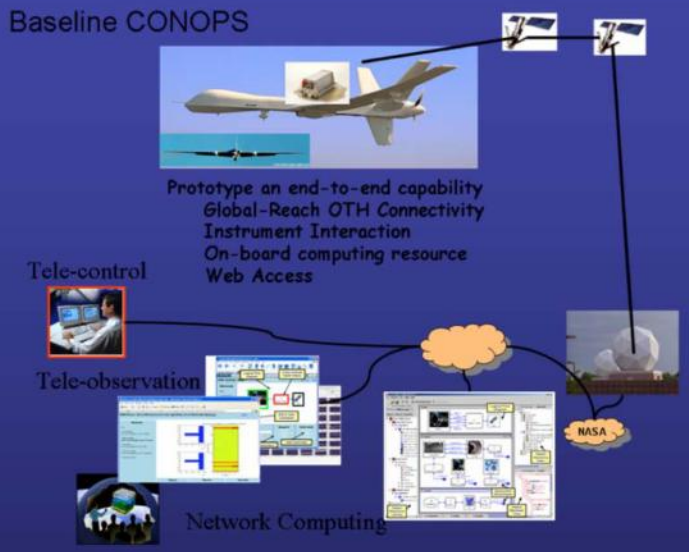
REVEAL: Brief History

- **Focus: Network Test/Measurement (2000-2003)**
  - Need tool for sensor webs, onboard computing, network data mgmt
- **Focus: Suborbital Science Needs (2004-present)**
  - The future demands better capabilities; greater capacity to do useful work on UAVs
  - Network-centric approaches to payload integration, command, control, monitoring, operations concepts, etc. must emerge
  - Squeeze more value out of every flight hour
- **REVEAL Solution Approach**
  - Vehicle-independent interface for science instruments lowers costs and reduces risks
  - Software is important: Build on open standards; dynamically reconfigurable; design for broad class of sensor web and airborne instrument communication R&D applications.
  - A vehicle-independent network-savvy instrumentation & processing system
  - Deliver traditional airborne laboratory support items in a small package (~10 lbs)
  - Add affordable satcom for global-reach near realtime situational awareness
  - Add affordable terrestrial infrastructure for web access and distributed computing (not just the airborne stuff)



High Level Summary

- In first 2 years of a 5 year project Dryden/ESCD/OTH has implemented a prototype global-reach distribution system that enables cost-effective productivity improvements for airborne science operations. This system leverages network computing and is adaptable to multiple platforms
- On-board REVEAL system is a configurable managed gateway with a suite of capabilities designed to evolve and adapt to the needs of airborne science user communities. REVEAL is vehicle independent by design
- Already serving needs of multiple deployments with text chat, Internet access for onboard systems; interactive links with instruments & terrstrial users, onboard computing, situational awareness displays on ground.
- Useful and reliable, here and now; capabilities grow with each deployment.
- Part of NASA's emerging sensor web capability